LUNAR SIMULANTS: JSC-1 IS GONE; THE NEED FOR NEW STANDARDIZED ROOT SIMULANTS

James L. Carter[1], David S. McKay[2], Lawrence A. Taylor[3], & W. David Carrier III[4]
1 Dept. of Geosciences, University of Texas at Dallas, Richardson, TX 75083 jcarter@utdallas.edu
2 Planetary Exploration, Johnson Space Center, Houston, TX 77058 david.s.mckay@jsc.nasa.gov
3 Planetary Geosciences Institute, University of Tennessee, Knoxville, TN 37996 lataylor@utk.edu
4 Lunar Geotechnical Institute, Lakeland, FL 33807-5056 dcarrier@tampabay.rr.com.

A workshop [1] was held in 1991 to evaluate the status of simulated lunar regolith material and to make recommendations on future requirements and production of such material. As an outgrowth of that workshop, a group centered at Johnson Space Center (JSC) teamed with James Carter of the University of Texas at Dallas and Walter Boles of Texas A&M University to produce and distribute a new standardized lunar regolith simulant termed JSC-1. Carter supervised the field collection, shipping, processing, and initial packaging and transportation of JSC-1. Boles stored and distributed JSC-1. About 25 tons were created and distributed to the lunar science and engineer community; none is left for distribution. JSC-1 served an important role in concepts and designs for lunar base and lunar materials processing. Its chemical and physical properties were described by McKay et al. [2], with its geotechnical properties described by Klosky et al. [3]. While other lunar regolith simulants were produced before JSC-1 [4-6], they were not standardized, and results from tests performed on them were not necessarily equivalent to test results performed on JSC-1. JSC-1 was designed to be chemically, mineralogically, and texturally similar to a mature lunar mare regolith (low titanium). The glass-rich character of JSC-1 (~50%) produced quite different properties compared to other simulants that were made entirely of comminuted crystalline rock, but properties similar to lunar mare near surface regolith.

While it would be difficult to completely duplicate JSC-1, it should be a model for new simulants in which the chemical and physical properties of the lunar regolith are duplicated as closely as possible. We propose that the concept of a standardized simulant be followed by the community, in which large quantities (more than 100 tons) of simulant is produced in a manner that homogenizes it so that all subsamples are equivalent. From this root simulant it would then be possible to produce other more specialized simulants, for example, by implanting solar wind, by adding ice in various proportions, or by adding specific components such as metallic iron, carbon, organics, or halogens to more closely simulate special properties of lunar regolith needed for specific kinds of tests and experiments. In all cases, the specialized simulant branches should begin with the standardized root simulant. While JSC-1 was a mare simulant, an additional root highland simulant would be desirable. Many of the proposed landing sites are in highland terrain, and the properties of lunar highland regolith have some fundamental differences compared to mare regolith. Consequently, we suggest that it is important to design and produce a standardized root highland simulant, as well.

We also propose that the new root lunar simulants be collected at a single locality and characterized by a science and engineering team. New security restrictions make it difficult for JSC to be the collection and distribution site; it will be necessary to perform this service elsewhere. While JSC-1 was distributed at no cost to the customers other than shipping, in this new era of full-cost accounting, the new lunar simulants must be paid for by the customers.

Although preparations are underway for the production of JSC-2, a "clone" of JSC-1, it would appear that a workshop is necessary to bring the community together to form a consensus on requirements for new lunar standardized root simulants and for some of the specialized branch simulants.

REFERENCES: [1] McKay, D.S. and Blasic, J.D. (1991) Workshop on Production and Uses of Simulated Lunar Materials, LPI Tech Report 91-04, 83pp; [2] McKay et al. (1994) Space IV, ASCE, 857-866; [3] Klosky et al. (1996) Space V, ASCE, 680-688; [4] Weiblen et al. (1990) Space II, ASCE, 428-435; [5] Desai et al. (1992) J. Aerospace Eng. 5, 425-441; [6] Chua et al. (1994) Space IV, ASCE, 867-877.